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NEW DATA ON READABILITY.

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READABILITY RESEARCHERS HAVE MADE ADVANCES IN THE PAST FEW YEARS, INCREASING THE ACCURACY OF READABILITY FORMULAS BY AS MUCH AS 75 PERCENT. THIS PROGRESS WAS POSSIBLE LARGELY BECAUSE RESEARCHERS IN SEVERAL DISCIPLINES DEVELOPED RESEARCH TOOLS WHICH AIDED IN THE STUDY OF READABILITY. PSYCHOLOGISTS DEVELOPED THE CLOZE PROCEDURE INTO AN ACCURATE AND RELIABLE METHOD OF MEASURING LANGUAGE DIFFICULTY. LINGUISTS DEVELOPED DESCRIPTIONS OF VARIOUS FEATURES OF LANGUAGE, AND THESE DESCRIPTIVE DEVICES WERE ADDED INTO NEW TECHNIQUES FOR MEASURING THE FEATURES OF LANGUAGE THAT INFLUENCE ITS COMPREHENSION DIFFICULTY. FINALLY, ADVANCES IN THE UNDERSTANDING OF THE MATHEMATICS USED BY READABILITY RESEARCHERS LED TO IMPROVED DESIGNS FOR READABILITY FORMULAS. THE RESULTS OF THIS PROGRESS IS THAT, WITHIN A YEAR OF TWO, EDUCATORS WILL HAVE IMPROVED TOOLS FOR DETERMINING WHETHER INSTRUCTIONAL MATERIALS ARE SUITABLE FOR USE WITH THEIR STUDENTS. THIS PAPER WAS PRESENTED AT A MEETING COSPONSORED BY THE INTERNATIONAL READING ASSOCIATION AND THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION (SEATTLE, MAY 5, 1967). (AUTHOR/BL)

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New Data on Readability

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Reading and language specialists are avid students of readability research, for this research attempts to discover what makes language easy or difficult to understand. Readability researchers study the correlations between various features of language and the difficulty children have in understanding language. This provides the specialists with the information they need to tailor instructional materials to fit the reading abilities of their students. It also provides them with readability formulas by which they can determine if commercially prepared materials are suitable for their students. Finally, by studying how the many features of language influence comprehension, readability research provides insights into the nature of the comprehension process, itself.

The past few years have been rapid and somewhat startling developments in readability research. For example, the readability formulas available only three years ago could, at best, predict only 25 to 50 per cent of the variation we observe in the difficulties of instructional materials. Today, we have not one, but two proto-type formulas, which are able to predict 85 to 95 per cent of the

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variation. This represents a very high level of precision and an improvement of from 35 to 75 per cent over the validities of older readability formulas. The purpose of this paper is to describe some of the results of this research and the efforts currently being made to forge our newly gained knowledge into practical educational tools.

Among the most important events leading up to the present developments was the publication of two books summarizing the readability research done up to that time. One was by Chall (1958) and the other by Klare (1963). From these books it became clear that the future readability research had to concentrate on three problems. First, a more reliable method had to be developed for measuring the difficulty children have in understanding materials. Second, researchers had to learn to measure and describe the linguistic features of materials that are really important in affecting comprehension. Third, investigators had to analyze their data in far more detail than they had up to that time. What follows is an account of what resulted when efforts were made to attack each of these problems.

Measurement of Comprehension Difficulty

Problem: Until recently, investigators used multiple choice tests to determine the comprehension difficulties of materials. They made a test over each passage they were studying, tested the students after they had read each passage, and then found the mean percentage of questions answered correctly. The test means represented the difficulties of the passages. This method presented two problems. First, because the test was itself a reading task, the investigator was never quite certain whether he was measuring the difficulty of the passage or just the difficulty of the test questions. Second, these tests could tell

him nothing about how difficult each word, phrase, or sentence in the passage was.

Construction of Cloze Tests: Shortly before Chall and Klare published their books, Taylor (1953) reported his first work with the cloze procedure. The cloze readability procedure can be used to make tests from any verbal instructional material. To do so, the investigator selects the passage he wishes to study, deletes every fifth word, and replaces the deleted words with underlined blank spaces of a standard length. The test is given to children who have not previously read the passage, and they are instructed to write in each blank the word they think was deleted. Their responses are scored correct when they exactly match the words deleted, except that miss-spellings are disregarded.

Advantages: Cloze readability procedure does not confuse the measurement of passage difficulty by injecting an extraneous reading task into the process. It also has the added advantage that investigators could measure the difficulty of every word, phrase, or sentence in a passage.

Research: The cloze readability procedure immediately drew the attention of readability researchers who set about studying cloze tests to see if they were valid and reliable measures of the comprehension difficulties of passages. This research has become far too extensive to review here. Bormuth (1967) and Rankin (1964) have each published detailed analyses of this research. In general, the research showed that cloze readability tests are highly valid and highly reliable measures of the comprehension abilities of students and of the comprehension difficulties of materials.

Description and Measurement of Language

Early researchers felt a need to make their formulas so simple they could be used even by clerks having little technical knowledge of language. For example, to determine the complexity of a word, the clerk either counted its syllables or looked it up to see if it was on a list of words thought to be easy. To determine the grammatical complexity of a sentence, the clerk had only to count the number of words, and sometimes prepositions, in the sentence. While it was, at that time, important for formulas to be simple, the old formulas vastly over-simplify the rich array of language features that influence its comprehension difficulty. The over-simplification also contributed to the fact that the old formulas were inaccurate.

Vocabulary Complexity

Present investigators are probing more deeply into the question of what makes a word difficult to understand. It is not enough to say that the words on some list have been shown to be easier to understand, for this leaves us still asking which of a word's many meanings did children understand and why those words are easier for students. Nor is it practical to test all words directly on children, especially when we consider that most words have several meanings. What follows is a discussion of some of the features currently being investigated.

Word Length: Children have always thought of long words as hard and short words as easy, and researchers have recently rediscovered this fact and begun investigating word length as a variable. Coleman (1961) found that a word's difficulty has a correlation of -.90 with both the number of letters and the number of syllables in the words. Bormuth (1966) found correlations of -.76 and -.68, respectively, for the same measures.

Morphological Complexity: A word is often a complex structure which may be analyzable into a stem and a series of inflectional, derivational, and lexical affixes. It seems that this is an important source of difficulty in understanding words. Coleman (1961) found that word difficulty had a correlation of -.88 with the number of affixes and stems into which a word could be analyzed and a correlation of the same size with the number of inflectional morphemes.

Abstractness: Although there are almost as many meanings of the word abstractness as there are people who use it, nearly everyone agrees that, whatever it is, it has an influence on the difficulty of a word. Coleman (1966) devised a definition which permitted him to count reliably the number of nouns that referred to internal mental states and found that this number had a correlation of -.78 with passage difficulty.

Frequency: It has long been known that the frequency with which a word is used has some influence on the difficulty people have in understanding it. But, frequency was thought to be a weak variable since Lorge (1949) had found only a correlation of .51 between it and difficulty. More recently, Bormuth (1966) has shown that frequency and difficulty have a curvilinear relationship and that, when this fact is taken into account, they have a correlation of .66. Klare (1967) has now taken a position that the frequency of a word may directly reflect most of the other characteristics of the word.

Grammatical Complexity

The degree of intricacy of the grammatical relationships between the parts of a sentence has always been considered an important source of the difficulty in understanding the sentence. Until recently, the chief means of assessing

grammatical complexity consisted of counting the number of words in sentences.

Two major objections can be raised to considering sentence length as the sole factor affecting grammatical complexity. First, it forces us to accept the dubious proposition that all sentences containing the same number of words possess the same degree of complexity. Thus, we are asked to believe that the sentence The man saw the boy who found the penny which was lost has the same degree of complexity as The penny which the boy whom the man saw found was lost. Second, the number of words in a sentence does not measure a natural unit of language. We cannot simply add or chop off a few words to make the sentences more or less complex.

The grammatical complexity of a sentence actually results from the grammatical structure of the sentence. Consequently, modern researchers are investigating measures of grammatical complexity based on the grammatical structures of sentences. This approach is given firm support by the experiments performed by Martin (1966) and Johnson (1966a, 1966b) which demonstrate that people utilize the phrase structure of sentences as they process the sentences.

Syntactic Depth: Yngve (1960) developed a measure of syntactic complexity which obtains the number of grammatical facts a reader must temporarily hold in his memory as he reads a sentence. Presumably, the more grammatical facts the reader must remember as he reads a sentence, the more likely he is to forget one of those facts and the more likely he is to fail to comprehend some aspect of the sentence. Bormuth (1964) and Martin (1966) have each shown that people's responses to sentences are closely related to the depth measures of the sentences. Bormuth (1966) found a correlation of -.55 between depth and passage difficulty. Further, he found (1963) that the effects produced by depth were independent of those produced by sentence length.

Modifier Distance: A variation on the depth measure was developed by Bormuth (1967) and is being investigated by him and by Coleman and Aquino (1967). This variable measures the number of words occurring between a word or phrase it modifies on the theory that the longer a grammatical fact is held in memory, the more likely it is that it will be forgotten. Preliminary results indicate that there is a correlation of -.80 to -.90 between this feature and passage difficulty.

Transformational Complexity: A sentence such as The little boy ran may be represented as resulting from a transformation which embedded the kernel sentence The boy was little into the kernel sentence The boy ran. Chomsky (1965) has argued that to interpret a sentence people must transform a sentence back into its kernel sentences.

An interesting aspect of the transformation analysis is the fact that it can be used to measure what early researchers referred to subjectively as being the idea density of materials. Coleman (1966) found that the number of nominalized verb and nominalized adjective transformations had correlations of -.76 and -.57, respectively, with passage difficulty. Many parts of speech represent transformations, also. Bormuth (1966) found that counts of the various parts of speech had correlations as high as .81 with passage difficulty. His present studies are analyzing the effects associated with each of the transformations found in English.

Contextual Variables

Modern researchers are looking beyond the word and the sentence to find the features of language that operate over longer segments of text to influence comprehension. Rosenberg (1966) found indications that passage[8] containing words which people tend to associate with each other are easier to recall. Coleman

and Aquino (1967) are finding that anaphoric analyses yield variables that predict passage difficulty. Anaphora are repeated references to a concept in a passage. The use of anaphora indicates the extent to which a passage deals in depth with a single topic. Since the work in this area is only beginning, it is still too early to predict its outcomes. But, it seems certain that gains in this area will have great value in increasing our ability to predict and control passage difficulty.

Readability Formulas

Early investigators had to defer the investigation of many important problems until research in other disciplines had made tools available for studying those problems. As may be seen from the preceeding discussion, linguistic research provided readability researchers with new and powerful tools for analyzing language. Similarly, research tools became available for studying the problems involved in designing readability formulas. As a result, we have now learned enough to design much sounder readability formulas.

Readability and Reading Ability

A problem long plaguing researchers was the question of whether the features that influenced readability for poor readers also influenced the readability of materials for more able readers. If the same features of language influence readability for both and by the same amount, then a single and fairly simple formula can be used to predict readability for all students, regardless of their level of accomplishment in reading. But if different features influence difficulty for students of differing levels of reading achievement or if the same features influence difficulty by different amounts, then we must develop more complex and materially different kinds of formulas. Bormuth (1966) studied this problem

and found that, regardless of the person's reading ability, the same features of language that caused difficulty for him caused the same amount of difficulty for others.

Shapes of the Relationships

A second question was whether a given amount of increase in a feature of the language increased difficulty regardless of how much was already present. For example, is the difference in difficulty between two and three syllable words as great as the difference in difficulty between 7 and 8 syllable words? If not, the simple correlation techniques used by early researchers yield misleading results. Bormuth (1966) found the differences were not always the same. Figuratively speaking, adding another syllable to a one syllable word increases its difficulty far more than adding another syllable to a seven syllable word. The same is true of many other features. Hence, future readability formulas must include appropriate transformations of measurements taken of these features.

Form of the Formulas

The traditional readability formulas are presented in the form of what is called a multiple variable, linear equation. These equations have a characteristic that makes them unsuitable for use as readability prediction formulas. To use them, the researcher must assume that any correlation observed between two variables, say sentence length and word length, must always exist. This simply is not true of the language features used in most formulas. The result is that the old formulas yield misleading results whenever the correlation is anything other than the correlation the formulas assume. Most future readability formulas will probably be designed to provide a profile of the level of difficulty represented by each of the language features in a passage.

Summary

Readability researchers have made rapid strides in the past few years, increasing the accuracy of readability formulas by as much as 75 per cent. The reason lies largely in the fact that researchers in several disciplines have developed research tools which have aided greatly the study of readability. Psychologists have developed the cloze procedure into an accurate and reliable method of measuring language difficulty. Linguists have developed descriptions of various features of language and these descriptive devices have been further adapted into powerful new techniques for measuring the features of language that influence its comprehension difficulty. Finally, advances in our understanding of the mathematics used in our analyses have lead to improved designs for readability formulas. The result of these advances is that, within a year or two, educators will have placed in their hands powerful new tools for determining if instructional materials are suitable for use with their students.

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